

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) A flow control device comprising:

an opening part through which an upstream side of a fluid flow passage is in communication with a downstream side of the fluid flow passage;

a valve element for closing the opening part, the valve element comprising:

a large flow rate controlling valve element capable of adjusting an opening degree of the opening part;

a sealing member provided with a valve hole having an open area smaller than the opening part and formed to be capable of being brought into tight contact with a peripheral wall part of the opening part; and

a small flow rate controlling valve element capable of adjusting an opening degree of the valve hole; and

a valve drive device which rotates to drive the valve element in a closed direction for closing the opening part or in an opened direction for opening the opening part,

wherein the small flow rate controlling valve element is a rod-shaped valve element formed so as to extend in a driving direction of the valve element,

wherein a front end portion of the rod-shaped valve element in the driving direction of the valve element is fixed to the large flow rate controlling valve element with a diameter larger than that of the valve hole of the sealing member,

wherein the sealing member is mounted to the rod-shaped valve element so as to be capable of forming a small flow rate state through a space between an outer face of the rod-shaped valve element and an inner face of the valve hole of the sealing member and a subsequent space between the sealing member and the large flow rate controlling valve element, and

wherein the space between the outer face of the rod-shaped valve element and the inner face of the valve hole of the sealing member is closed according to a further movement of the rod-shaped valve element in the driving direction of the valve element.

2. (Canceled)

3. (Currently amended) ~~The A flow control device according to claim 2, further comprising~~ comprising:

an opening part through which an upstream side of a fluid flow passage is in communication with a downstream side of the fluid flow passage;

a valve element for closing the opening part, the valve element comprising:

a large flow rate controlling valve element capable of adjusting an opening degree of the opening part;

a sealing member provided with a valve hole having an open area smaller than the opening part and formed to be capable of being brought into tight contact with a peripheral wall part of the opening part; and

a small flow rate controlling valve element capable of adjusting an opening degree of the valve hole;

a valve drive device which rotates to drive the valve element in a closed direction for closing the opening part or in an opened direction for opening the opening part; and

a motor as a driving source and a transmission mechanism which transmits an output of the motor to the valve element for moving the valve element in the opened direction or the closed direction,

wherein the sealing member comprises:

a closed state in which the sealing member is in tight contact with the peripheral wall part of the opening part to close the opening part and the valve hole of the sealing member is substantially closed by the small flow rate controlling valve element;

a small flow rate state in which an opening degree of the valve hole of the sealing member is adjusted by the small flow rate controlling valve element while the sealing member is in tight contact with the peripheral wall part of the opening part; and

a large flow rate state in which the sealing member is moved apart from the peripheral wall part of the opening part by the large flow rate controlling valve element such that the opening degree of the opening part is adjusted by the large flow rate controlling valve element.

4. (Currently amended) The flow control device according to claim 1, wherein the ~~small flow rate controlling valve element is a rod-shaped valve element formed so as to extend in a driving direction of the valve element and is fit within the valve hole so as to be movable within the valve hole, a front end portion of the rod-shaped valve element is fixed to the large flow rate controlling valve element with a diameter larger than that of the valve hole of the sealing member, is movable along with the large flow rate controlling valve element in an integral manner, and is capable of adjusting a clearance area to an~~ the inner face of the valve hole of the sealing member according to a penetrating depth of the rod-shaped valve element into the valve hole of the sealing member, and the sealing member moves apart from the opening part in a large flow rate state.

5. (Original) The flow control device according to claim 4, wherein the rod-shaped valve element is formed in such a manner that a mid portion of the rod-shaped valve element has an outer diameter capable of substantially closing the valve hole of the sealing member and a front end side part from the mid portion is formed thinner such that a diameter is slightly decreased towards an end portion of the front end side part of the rod-shaped valve element.

6. (Original) The flow control device according to claim 4, further comprising a spring member disposed around the rod-shaped valve element for energizing the sealing member towards the peripheral wall part of the opening part.

7. (Original) The flow control device according to claim 4, further comprising a groove-shaped flow passage formed between the sealing member and the large flow rate controlling valve element in a state that the large flow rate controlling valve element abuts the sealing member,

wherein a flow rate in the groove-shaped flow passage is roughly equal to a flow rate when the opening degree of the opening part is minimized by the large flow rate controlling valve element.

8. (Currently amended) The A flow control device ~~according to claim 1,~~
~~further comprising~~ comprising:

an opening part through which an upstream side of a fluid flow passage is in communication with a downstream side of the fluid flow passage;

a valve element for closing the opening part, the valve element comprising:

a large flow rate controlling valve element capable of adjusting an opening degree of the opening part;

a sealing member provided with a valve hole having an open area smaller than the opening part and formed to be capable of being brought into tight contact with a peripheral wall part of the opening part; and

a small flow rate controlling valve element capable of adjusting an opening degree of the valve hole; and

a valve drive device which rotates to drive the valve element in a closed direction for closing the opening part or in an opened direction for opening the opening part,

wherein a front end portion of the large flow rate controlling valve element is formed narrowly tapered such that a diameter of the front end portion of the large flow rate controlling valve element ~~decrease~~ decreases towards a front end side, and

wherein the tapered front end portion of the large flow rate controlling valve element enters into an inner side of the opening part and is capable of adjusting the opening degree of the opening part.

9. (Currently amended) The A flow control device ~~according to claim 1~~
comprising:

an opening part through which an upstream side of a fluid flow passage is in
communication with a downstream side of the fluid flow passage;

a valve element for closing the opening part, the valve element comprising:

a large flow rate controlling valve element capable of adjusting an opening
degree of the opening part;

a sealing member provided with a valve hole having an open area smaller
than the opening part and formed to be capable of being brought into tight contact
with a peripheral wall part of the opening part; and

a small flow rate controlling valve element capable of adjusting an opening
degree of the valve hole; and

a valve drive device which rotates to drive the valve element in a closed
direction for closing the opening part or in an opened direction for opening the
opening part,

wherein the valve element is driven by the valve drive device so as to follow
an arc-shaped trajectory and the opening art is formed opened in a peripheral
direction so as to be inserted by the large flow rate controlling valve element.

10. (Original) The flow control device according to claim 9, wherein both the
large flow rate controlling valve element and the small flow rate controlling valve
element are formed a curved shape so as to be along the arc-shaped trajectory of the
valve element.

11. (Currently amended) A flow control device comprising:

an opening part through which an upstream side of a fluid flow passage is in
communication with a downstream side of the fluid flow passage;

a valve element for closing the opening part, the valve element comprising:

a large flow rate controlling valve element capable of adjusting an opening
degree of the opening part;

a sealing member provided with a valve hole having an open area smaller than the opening part and formed to be capable of being brought into tight contact with a peripheral wall part of the opening part; and

a small flow rate controlling valve element capable of adjusting an opening degree of the valve hole; and

means for rotating to drive the valve element in a closed direction for closing the opening part or in an opened direction for opening the opening part,

wherein the small flow rate controlling valve element is a rod-shaped valve element formed so as to extend in a driving direction of the valve element,

wherein a front end portion of the rod-shaped valve element in the driving direction of the valve element is fixed to the large flow rate controlling valve element with a diameter larger than that of the valve hole of the sealing member,

wherein the sealing member is mounted to the rod-shaped valve element so as to be capable of forming a small flow rate state through a space between an outer face of the rod-shaped valve element and an inner face of the valve hole of the sealing member and a subsequent space between the sealing member and the large flow rate controlling valve element, and

wherein the space between the outer face of the rod-shaped valve element and the inner face of the valve hole of the sealing member is closed according to a further movement of the rod-shaped valve element in the driving direction of the valve element.

12. (Canceled)

13. (Currently amended) ~~The A flow control device according to claim 12, further comprising~~ comprising:

an opening part through which an upstream side of a fluid flow passage is in communication with a downstream side of the fluid flow passage;

a valve element for closing the opening part, the valve element comprising:

a large flow rate controlling valve element capable of adjusting an opening degree of the opening part;

a sealing member provided with a valve hole having an open area smaller than the opening part and formed to be capable of being brought into tight contact with a peripheral wall part of the opening part; and

a small flow rate controlling valve element capable of adjusting an opening degree of the valve hole;

means for rotating to drive the valve element in a closed direction for closing the opening part or in an opened direction for opening the opening part; and

a motor as a driving source and a transmission mechanism which transmits an output of the motor to the valve element for moving the valve element in the opened direction or the closed direction,

wherein the sealing member comprises:

a closed state in which the sealing member is in tight contact with the peripheral wall part of the opening part to close the opening part and the valve hole of the sealing member is substantially closed by the small flow rate controlling valve element;

a small flow rate state in which an opening degree of the valve hole of the sealing member is adjusted by the small flow rate controlling valve element while the sealing member is in tight contact with the peripheral wall part of the opening part; and

a large flow rate state in which the sealing member is moved apart from the peripheral wall part of the opening part by the large flow rate controlling valve element such that the opening degree of the opening part is adjusted by the large flow rate controlling valve element.

14. (Currently amended) The flow control device according to claim 11, wherein the ~~small flow rate controlling valve element is a rod-shaped valve element formed so as to extend in a driving direction of the valve element and is~~ fit within the valve hole so as to be movable within the valve hole, ~~a front end portion of the rod shaped valve element is fixed to the large flow rate controlling valve element with a diameter larger than that of the valve hole of the sealing member, is~~ movable

along with the large flow rate controlling valve element in an integral manner, and is capable of adjusting a clearance area to ~~an~~ the inner face of the valve hole of the sealing member according to a penetrating depth of the rod-shaped valve element into the valve hole of the sealing member, and the sealing member moves apart from the opening part in a large flow rate state.

15. (Original) The flow control device according to claim 14, wherein the rod-shaped valve element is formed in such a manner that a mid portion of the rod-shaped valve element has an outer diameter capable of substantially closing the valve hole of the sealing member and a front end side part from the mid portion is formed thinner such that a diameter is slightly decreased towards an end portion of the front end side part of the rod shaped valve element.

16. (Original) The flow control device according to claim 14, further comprising a spring member disposed around the rod-shaped valve element for energizing the sealing member towards the peripheral wall part of the opening part.

17. (Original) The flow control device according to claim 14, further comprising a groove-shaped flow passage formed between the sealing member and the large flow rate controlling valve element in a state that the large flow rate controlling valve element abuts the sealing member,

wherein a flow rate in the groove-shaped flow passage is roughly equal to a flow rate when the opening degree of the opening part is minimized by the large flow rate controlling valve element.

18. (Currently amended) ~~The~~ A flow control device ~~according to claim 11,~~
~~further comprising comprising:~~

an opening part through which an upstream side of a fluid flow passage is in communication with a downstream side of the fluid flow passage;

a valve element for closing the opening part, the valve element comprising:

a large flow rate controlling valve element capable of adjusting an opening degree of the opening part;

a sealing member provided with a valve hole having an open area smaller than the opening part and formed to be capable of being brought into tight contact with a peripheral wall part of the opening part; and

a small flow rate controlling valve element capable of adjusting an opening degree of the valve hole; and

means for rotating to drive the valve element in a closed direction for closing the opening part or in an opened direction for opening the opening part,

wherein a front end portion of the large flow rate controlling valve element is formed narrowly tapered such that a diameter of the front end portion of the large flow rate controlling valve element decreases towards a front end side, and

wherein the tapered front end portion of the large flow rate controlling valve element enters into an inner side of the opening part and is capable of adjusting the opening degree of the opening part.

19. (Currently amended) ~~The~~ A flow control device ~~according to claim 11~~ comprising:

an opening part through which an upstream side of a fluid flow passage is in communication with a downstream side of the fluid flow passage;

a valve element for closing the opening part, the valve element comprising:

a large flow rate controlling valve element capable of adjusting an opening degree of the opening part;

a sealing member provided with a valve hole having an open area smaller than the opening part and formed to be capable of being brought into tight contact with a peripheral wall part of the opening part; and

a small flow rate controlling valve element capable of adjusting an opening degree of the valve hole; and

means for rotating to drive the valve element in a closed direction for closing the opening part or in an opened direction for opening the opening part,

wherein the valve element is driven by means for rotating to drive so as to follow an arc-shaped trajectory and the opening part is formed opened in a

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peripheral direction so as to be inserted by the large flown rate controlling valve element.